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Authors: [Ciardullo, Robin](#); [Gronwall, Caryl](#); [Wolf, Christopher](#); [McCathran, Emily](#); [Bond, Nicholas A.](#); [Gawiser, Eric](#); [Guaita, Lucia](#); [Feldmeier, John . J.](#); [Treister, Ezequiel](#); [Padilla, Nelson](#); [Francke, Harold](#); [Matkovic, Ana](#); [Altmann, Martin](#); [Herrera, David](#)
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Abstract

We describe the results of a new, wide-field survey for $z=3.1$ Ly-alpha emission-line galaxies (LAEs) in the Extended Chandra Deep Field South (ECDF-S). By using a nearly top-hat 5010 Angstrom filter and complementary broadband photometry from the MUSYC survey, we identify a complete sample of 141 objects with monochromatic fluxes brighter than $2.4E-17$ ergs/cm²/s and observers-frame equivalent widths greater than ~ 80 Angstroms (i.e., 20 Angstroms in the rest-frame of Ly-alpha). The bright-end of this dataset is dominated by x-ray sources and foreground objects with GALEX detections, but when these interlopers are removed, we are still left with a sample of 130 LAE candidates, 39 of which have spectroscopic confirmations. This sample overlaps the set of objects found in an earlier ECDF-S survey, but due to our filter's redder bandpass, it also includes 68 previously uncataloged sources. We confirm earlier measurements of the $z=3.1$ LAE emission-line luminosity function, and show that an apparent anti-correlation between equivalent width and continuum brightness is likely due to the effect of correlated errors in our heteroskedastic dataset. Finally, we compare the properties of $z=3.1$ LAEs to LAEs found at $z=2.1$. We show that in the ~ 1 Gyr after $z\sim 3$, the LAE luminosity function evolved significantly, with L^* fading by ~ 0.4 mag, the number density of sources with $L > 1.5E42$ ergs/s declining by $\sim 50\%$, and the equivalent width scale-length contracting from 70^{+7}_{-5} Angstroms to 50^{+9}_{-6} Angstroms. When combined with literature results, our observations demonstrate that over the redshift range $z\sim 0$ to $z\sim 4$, LAEs contain less than $\sim 10\%$ of the star-formation rate density of the universe.

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